Potential Contributions to the HMT from FSL

(Stan Benjamin, Woody Roberts, John McGinley)

- Regional Modeling - Stan
- Local Modeling - John
- Workstations, Grid Manipulation, Product Display - Woody

FSL WRF Rapid Refresh forecasts for HMT

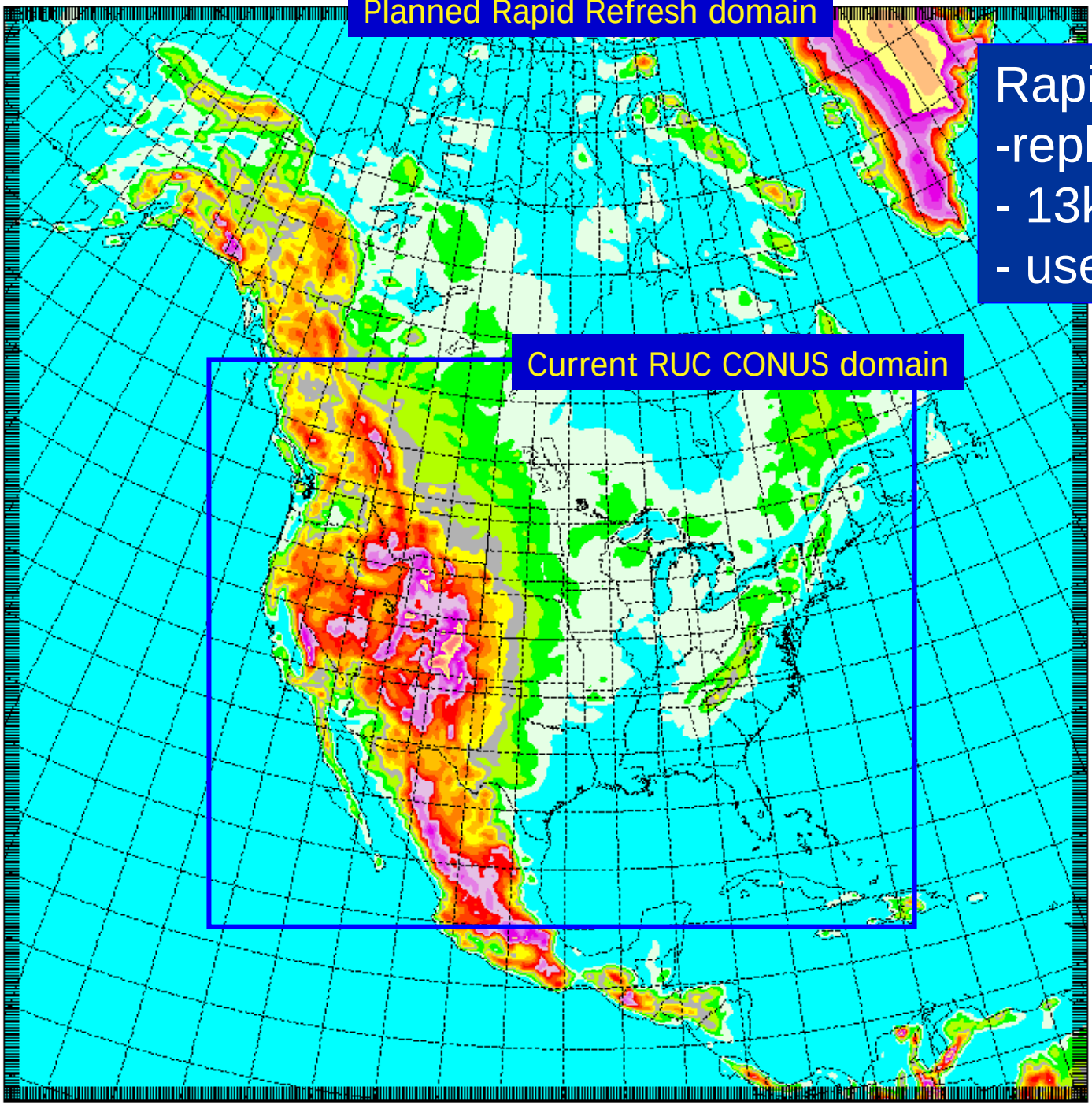
(following previous FSL/RUC experiments with PACJET)

GOALS

- Provide real-time model guidance from an advanced version of the WRF Rapid Refresh model – support field exercises

- Assess forecast skill for advanced WRF Rapid Refresh

- Evaluate forecast impact from new data sources including sat/GWINDEX winds



Rapid Refresh
-replace RUC – 2007
- 13km resolution
- use WRF model

Goals:
Hourly NWP update in

- Alaska
- Wider E. Pacific
-- Canada
- Caribbean Sea

Observations used in RUC/RR

Data Type	~Number	Freq.
Rawinsonde	80	/12h
NOAA profilers	30	/ 1h
VAD winds	110-130	/ 1h
Aircraft (V,temp)	1400-4500	/ 1h
Surface/METAR	1500-1700	/ 1h
Buoy/ship	100-150	/ 1h
GOES precip water	1500-3000	/ 1h
GOES cloud winds	1000-2500	/ 1h
GOES cloud-top pres	10 km res	/ 1h
SSM/I precip water	1000-4000	/ 6h
GPS precip water	~300	/ 1h
Mesonet	~6000	/ 1h
PBL – prof/RASS	~25	/ 1h
METAR-cloud-vis-wx	~1500	/ 1h
Radar / lightning	4km	/ 1h
GOES/POES radiances		/ 1h

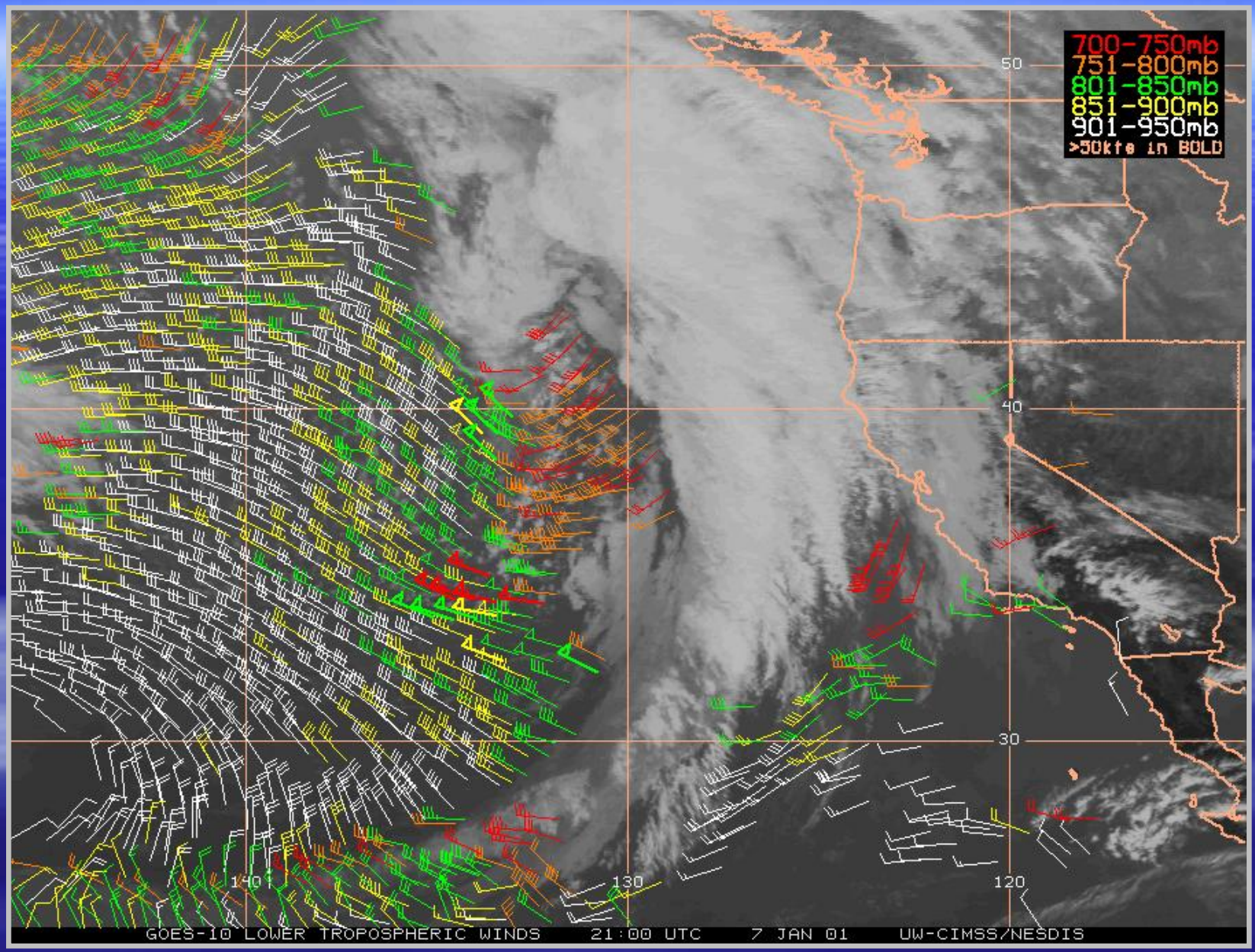
Cloud analysis variables

NCEP RUC20 operational

RUC13 (at NCEP May 2005)

- FSL only – Rapid Refresh using GSI analysis

Sample rapid-scan cloud-drift wind plot



Data impact tests using GWINDEX cloud-drift wind observations

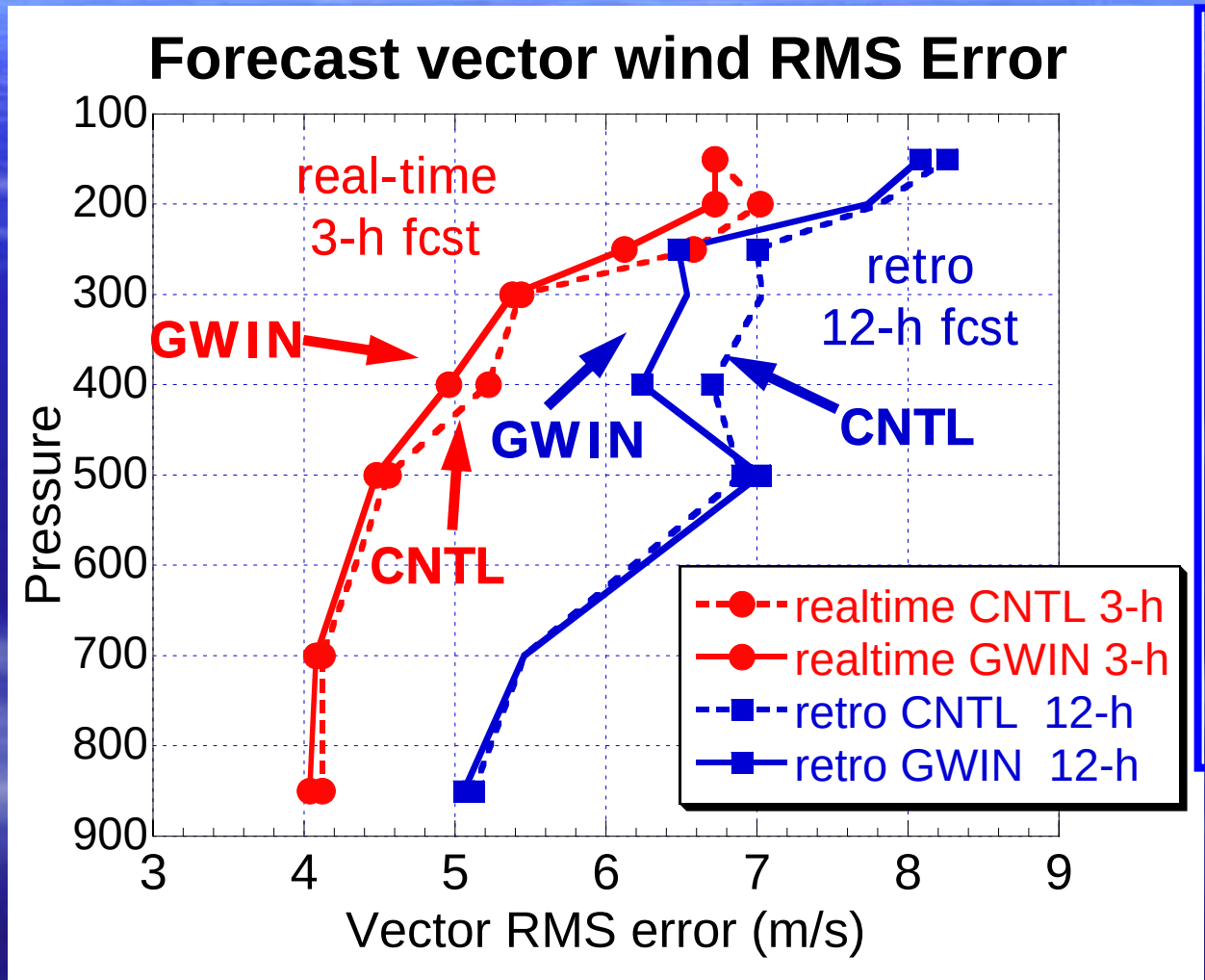
- Results from two 3-day periods
  - 25-28 March 2001 (real-time)
  - 6-8 February 2001 (retrospective)
- Compare forecasts using:
  - all standard obs (CNTL)
  - all standard obs + rapid-scan winds (GWIN)
- 1-h forecast cycle for both experiments
- Verify 3-, 6-, 9-, 12-h forecasts against 35 sondes

25-28 March 2001
(real-time)

6-8 February 2001
(retrospective)

GWINDEX
up to 0.4
m/s better
at 250 mb
for 3-h fcst

GWINDEX
very little
impact for
12-h fcst
(not shown)

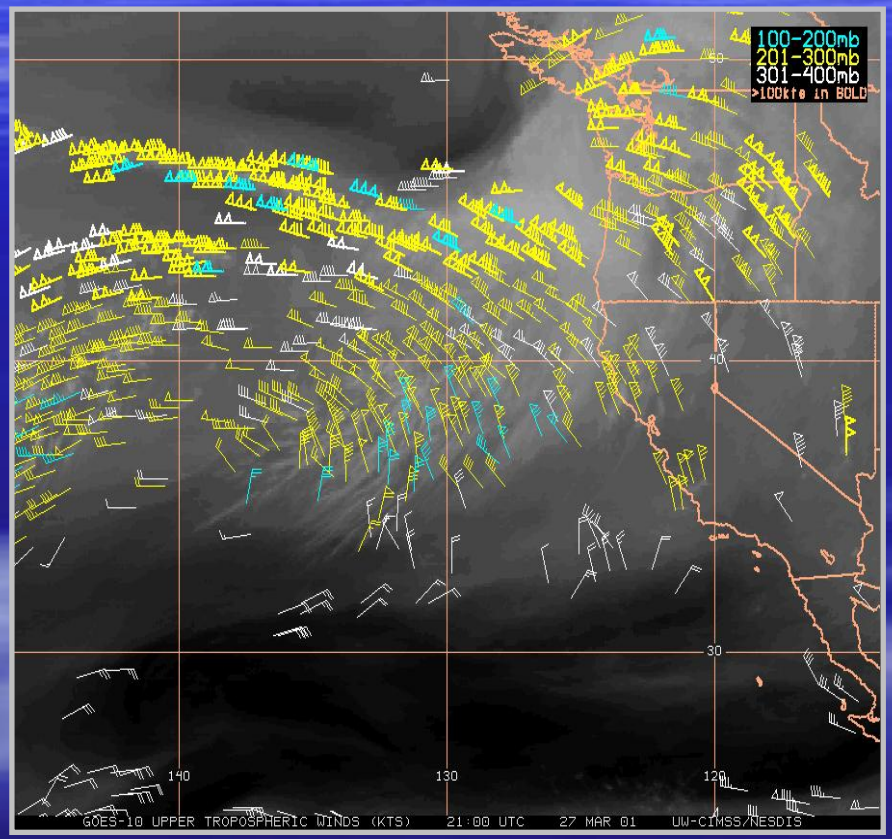


GWINDEX
very little
impact for
3-h fcst
(not shown)

GWINDEX
up to 0.6
m/s better
250-400
mb for
12-h fcst

25-28 March 2001 (real-time)

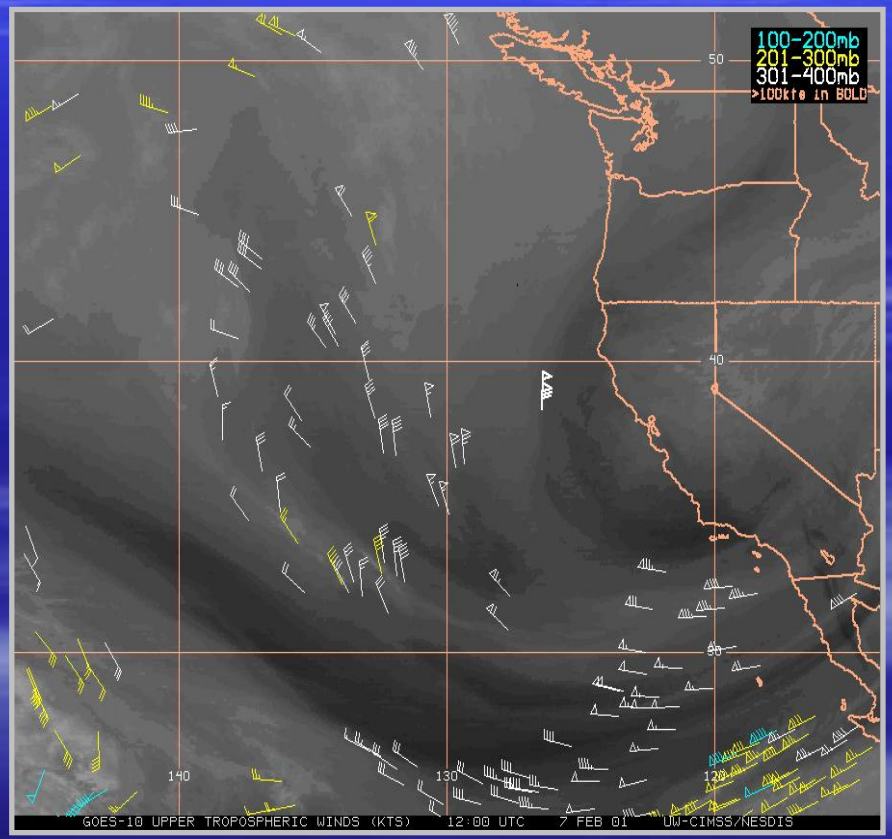
GWINDEX impact greater at +3h than +12h fcsts



many obs over land

6-8 February 2001 (retrospective)

GWINDEX impact greater at +12h than +3h fcsts



most obs over water

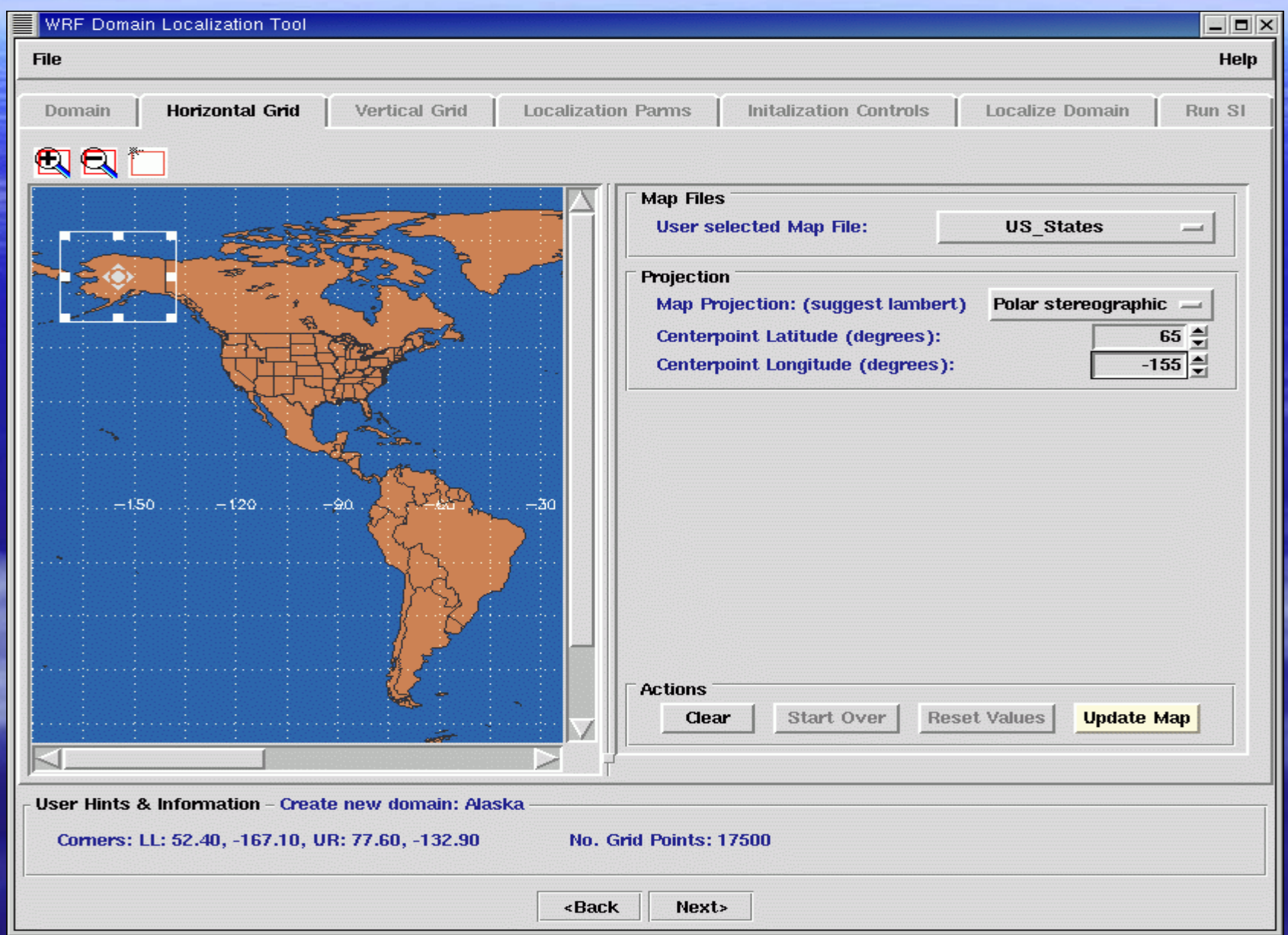
Contribution of FSL RR experiments in HMT

- Development of improved use of satellite data for short-range West Coast precipitation forecasting
- Use of larger eastern Pacific domain with WRF-based Rapid Refresh (replacing RUC)
    - Fairly high resolution – 13km
- Flexible test environment for new observations and new assimilation/modeling techniques (as with PACJET and NEHRT using RUC/WRFRUC)
- Well-defined transfer path into operational NCEP forecasting via Rapid Refresh

Local Modeling

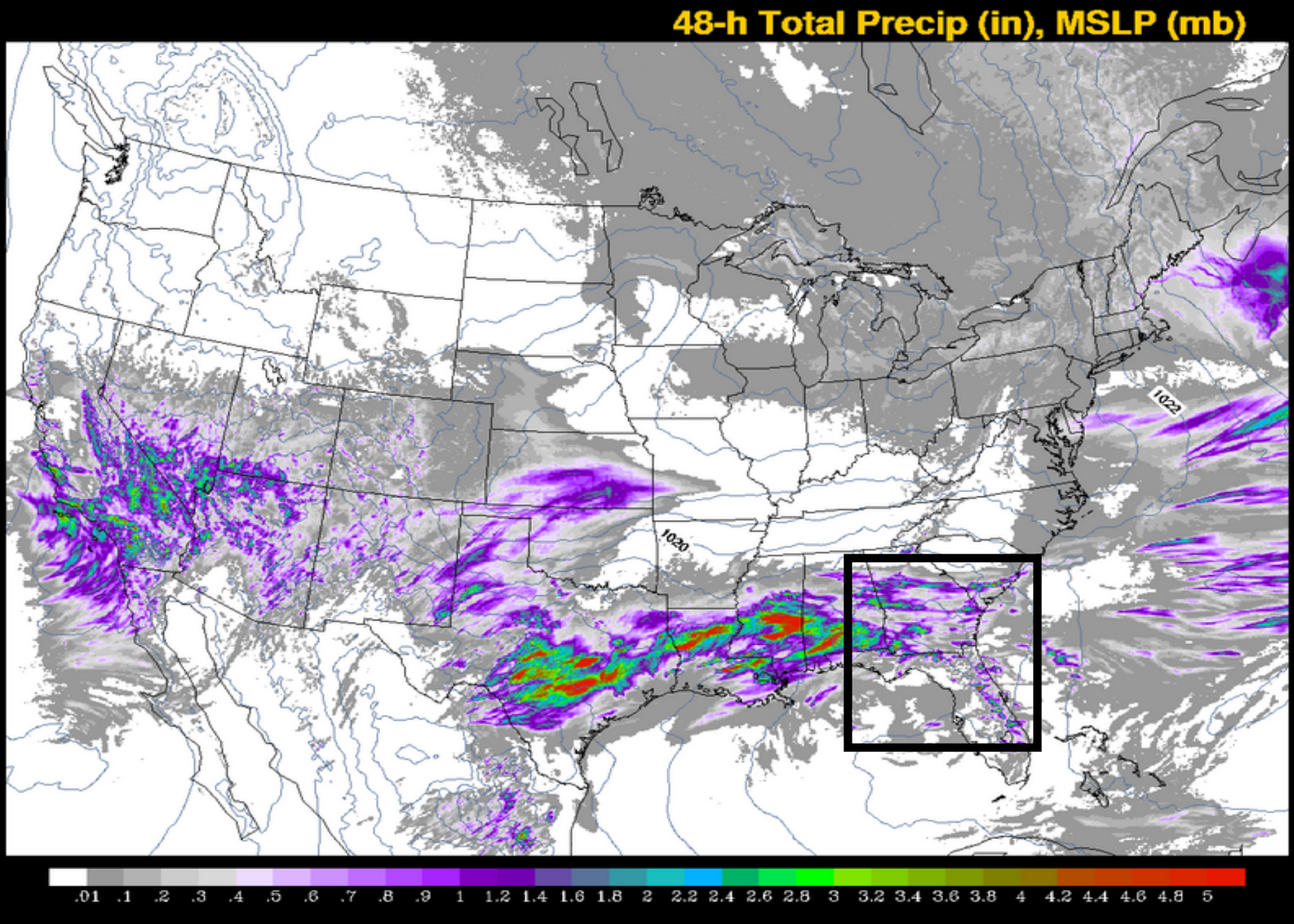
- Global Relocatability
- Many Background Options
- Nesting Options
- Diabatic Initialization/ Short Range QPF Focus
- Ensemble Capability
- Workstation Compatibility
- Experienced with Support to Field Exercises – IHOP, MDSS, CSI/ DLM

LAPS GUI – Global Locatibility



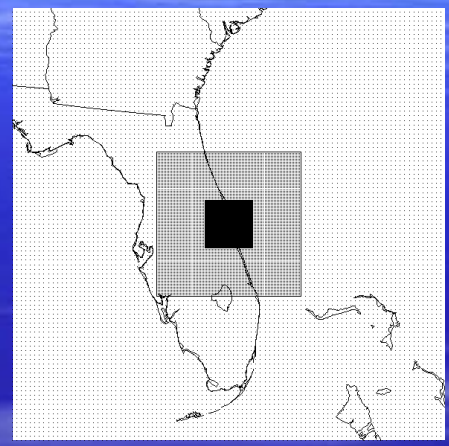
DWFE NMM 02/22/2005 (00:00) 48 hr fcst

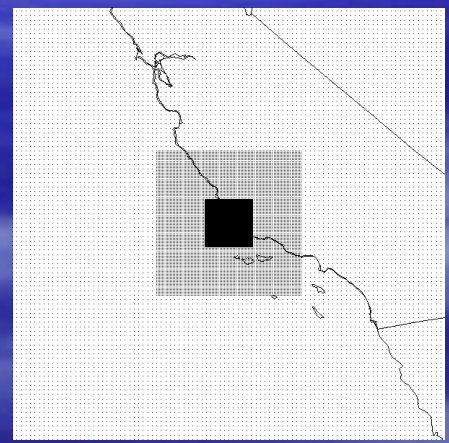
Valid 02/24/2005 00:00 UTC



Operational Applications For Space Launch Operations

- USAF Space Launch Facilities
  - Vandenberg and Cape Canaveral
  - LAPS and MM5
  - 10, 3.3, 1.1 km nests
  - Critical for launch and range safety weather forecasting
  - Utilizes local towers, profilers, miniSODARs, etc.
  - Operational “firsts”
    - AWIPS Integration
    - Linux cluster modeling



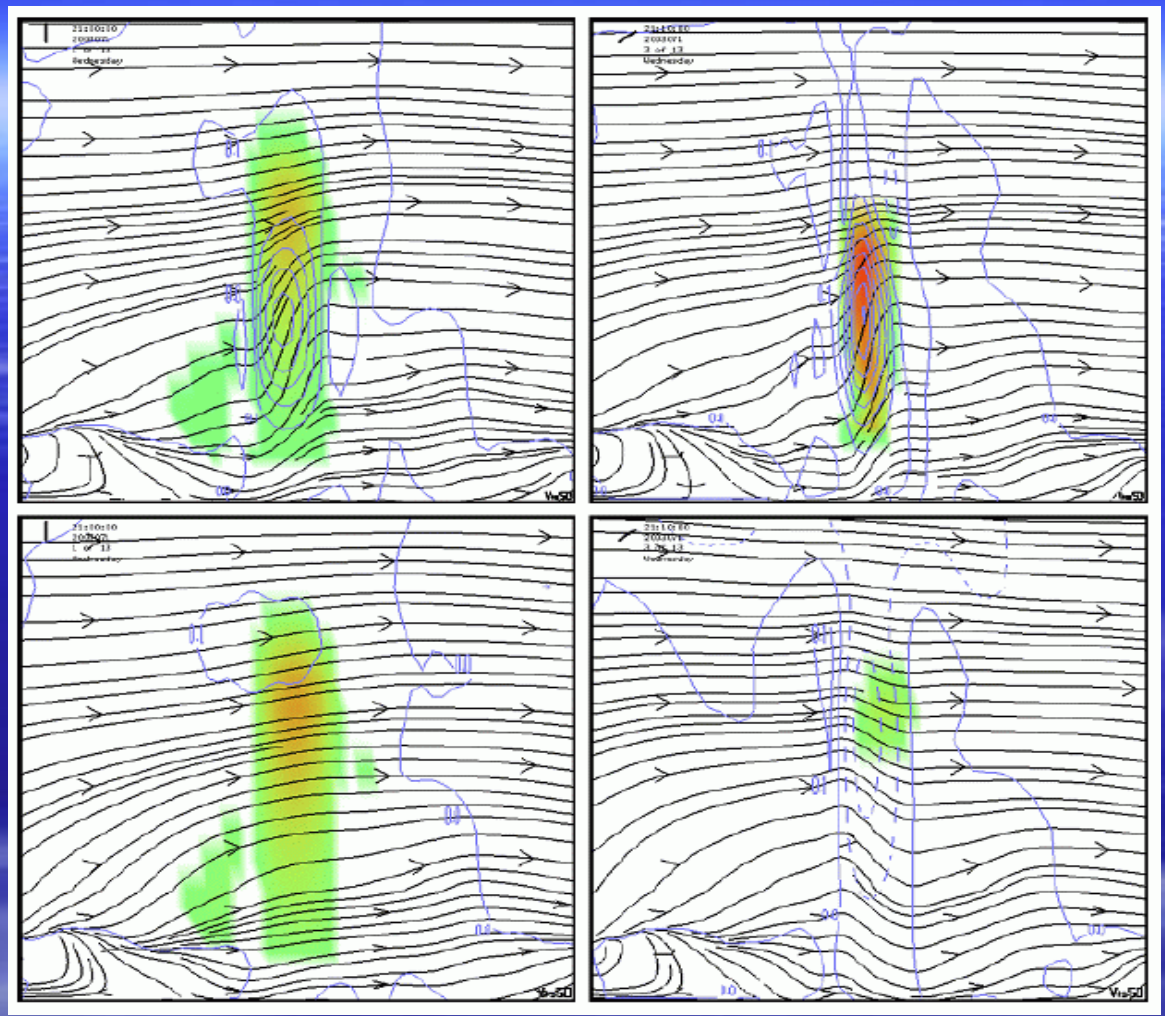


0-Hr

5 min forecast

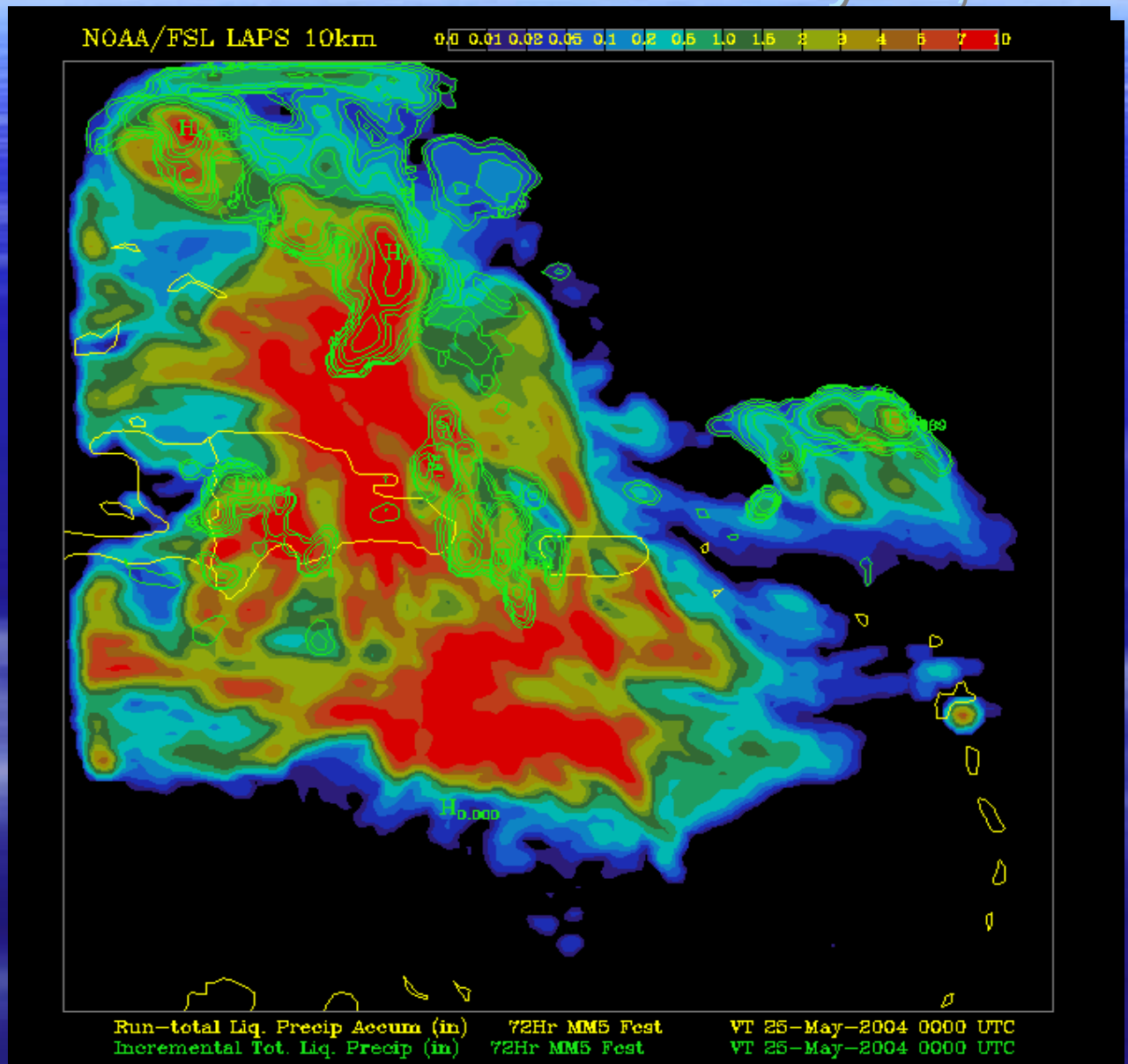
Hot Start

Cloud only
Cold start

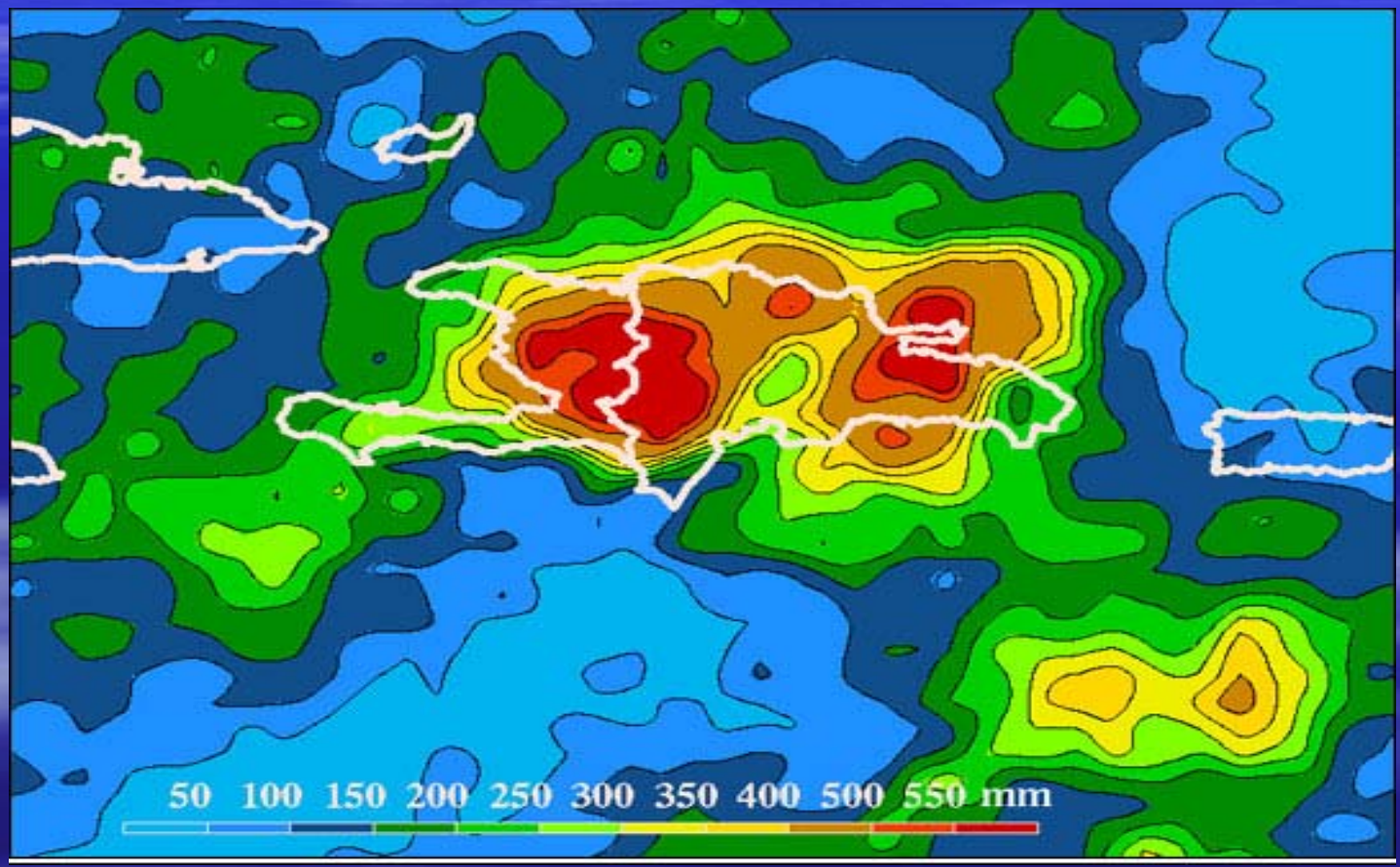


Clouds in initial condition – Cross-section
First 5 minutes

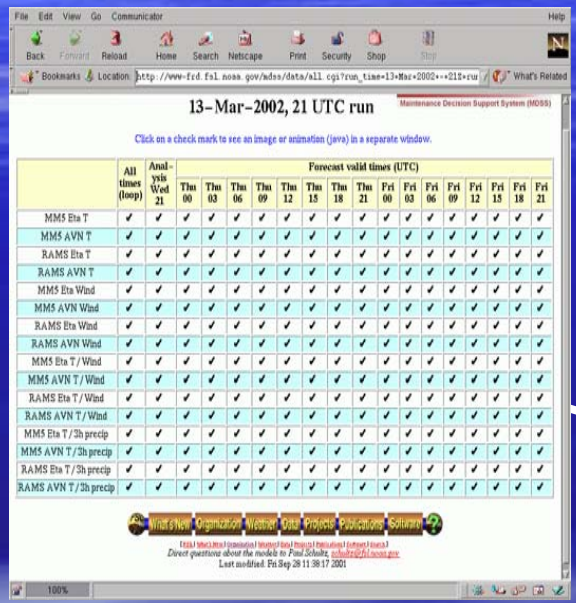
Window MM5 Forecast for Dominican Republic/ Haiti Flash Floods IT 00Z May 22, 2004



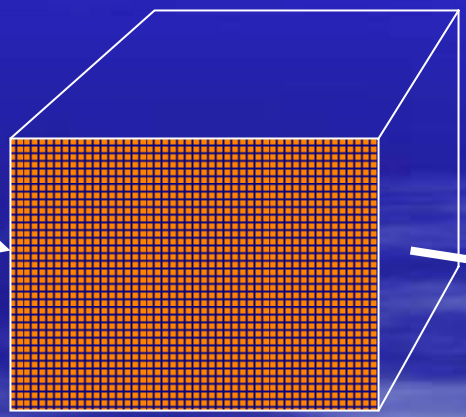
TRMM Rainfall Estimates
May 18-25, 2004 (NASA Goddard)



From Ensembles, to Probabilities, to Yes/No Forecasts and Improved Analyses



Ensemble



5-D model grids
(x,y,z,t,prob)

Location,
Time

Cost/Loss
Thresholds

Decision
Engine

Yes or No

Customer

Verifying
Analyses

B (error covariances)

Local Modeling Goals for HMT

- Set up fine scale domain for desired drainage basin (WRF-NMM)- consider multi nest
- Utilize RUC background
- Assimilate Cloud and Precipitation data (Satellite and Radar)
- Provide 0-24 hr forecasts - WFO operations (on WFO AWIPS) or SOP/IOP support
- Verify forecasts utilizing standard and experimental observational networks
- Set up time-phased ensemble for basin area (FSL) - evaluate utility of probabilistic forecasts
- Adapt rainfall/ hydro configuration for WFO DLM

Workstation Goals:

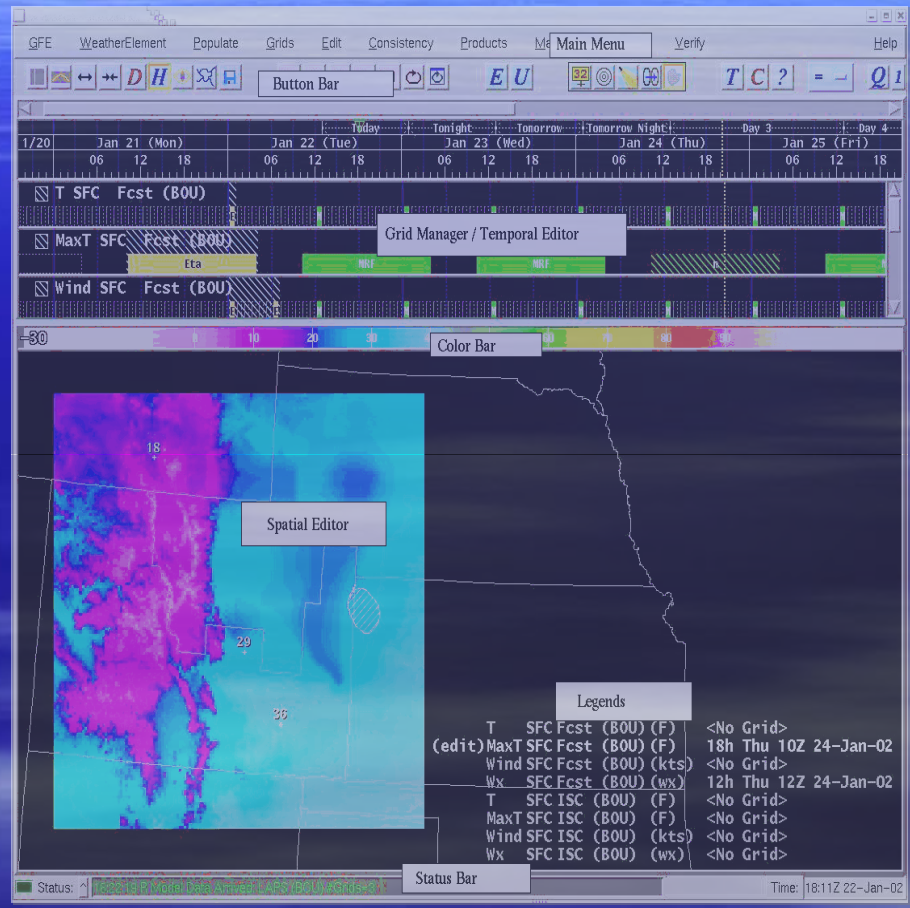
- Evaluate the efficacy and use of integrated advanced HMT datasets in a prototype AWIPS workstation (Advanced Linux Prototype - ALPS) , using a distributed database model for accessing experimental data sets in real time.
- Examine the forecast process for generating high-resolution QPF grids using advanced data sets, and the Graphical Forecast Editor (GFE) on ALPS.
- Evaluate the quality of experimental QPF grid forecasts generated in real time, compared to operational products, to see whether improvements are made and what factors lead to an improved product.

Advanced Linux Prototype - ALPS :

- Designed to greatly improve performance over current AWIPS system.
- Uses a distributed database model so experimental data sets can be integrated in real time along with traditional operational data sets
- The HMT will provide a venue to evaluate ALPS to determine which products and capabilities forecasters actually use to generate QPE and QPF during operational test periods.

GFE Evaluation Results:

- Forecasters use a variety of methods to initialize their forecast girds either using “smart” model initialization or simply copying the previous forecast period.
- Simple drawing tools (e.g.pencil tool) are used extensively in complex terrain to resolve and refine forecast weather elements.
- “Smart tools” and techniques are have been development but require much more refinement.



Targeted GFE development areas and Evaluations for HMT:

- Improved model initialization (“Smart Init.”) of forecast weather element grids.
- Better techniques (“Smart tools”) needed for refinements of weather element forecasts in complex terrain.
- Better techniques needed for adjusting forecast girds in rapidly-evolving weather scenarios.
- HMT will provide an opportunity to generate experimental QPF grids in real time for evaluation.

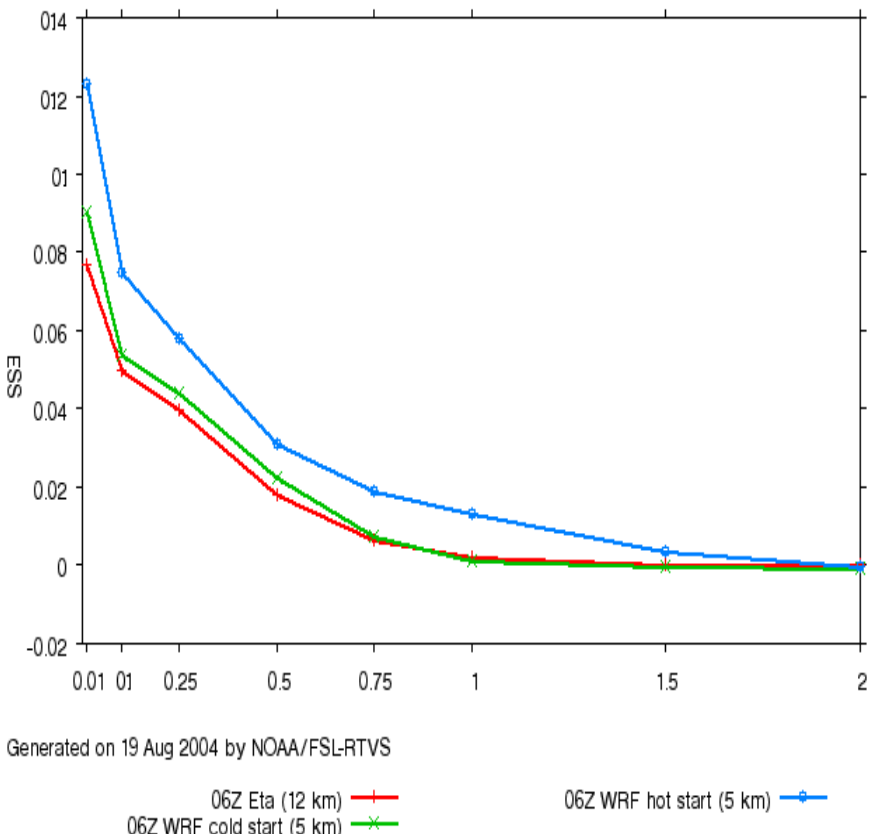
Summary

- Regional Modeling - Expanded RUC domain, real time forecasts, advanced data assimilation, validation
- Local Modeling - High resolution QPF, support for SOP/IOPs, ensemble applications, validation
- Workstation - ALPS assessment, GFE applications on QPF, validation of GFE QPF

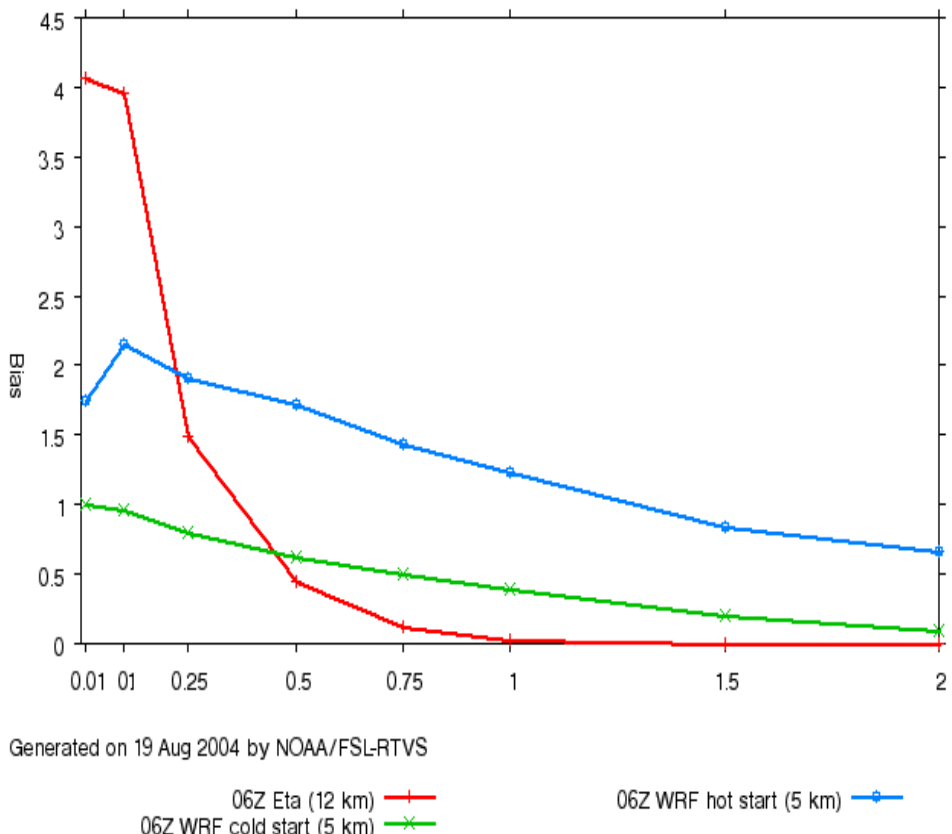
ESS & Bias Pcp, All Hrs, Jun03-Oct04

ETA WRF - BG Only WRF- HS

ESS



Bias

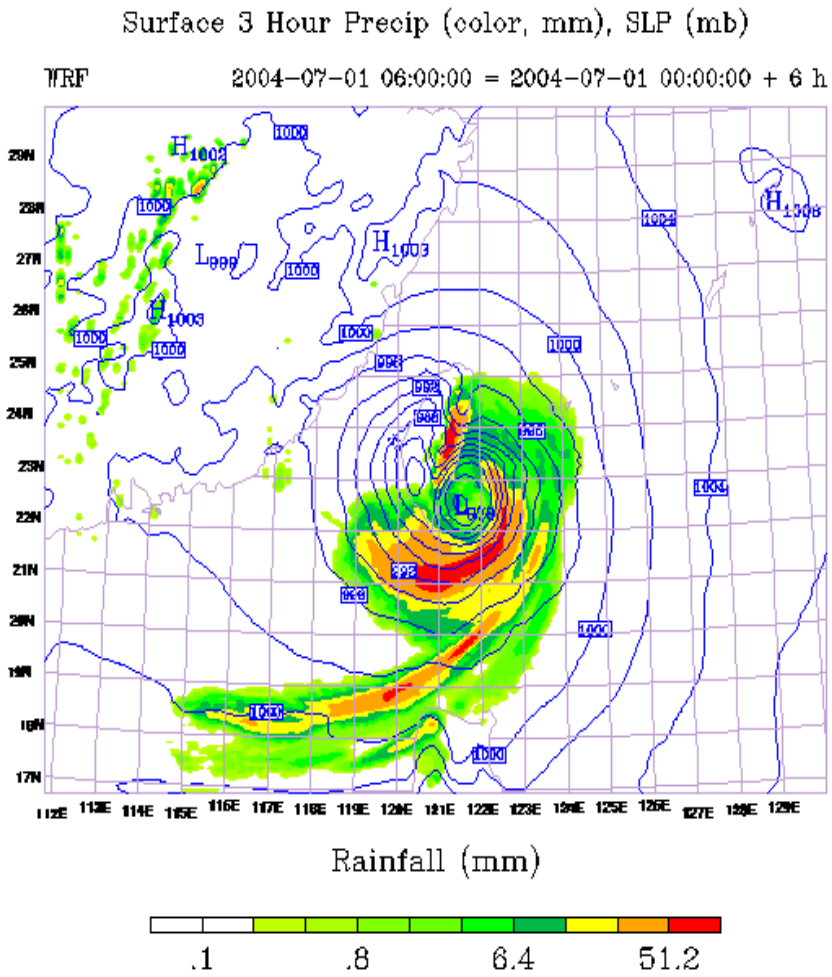


Surface Wind RMS Vector Error (m/s)
0600 GMT forecasts - Jun03 to Jul 04

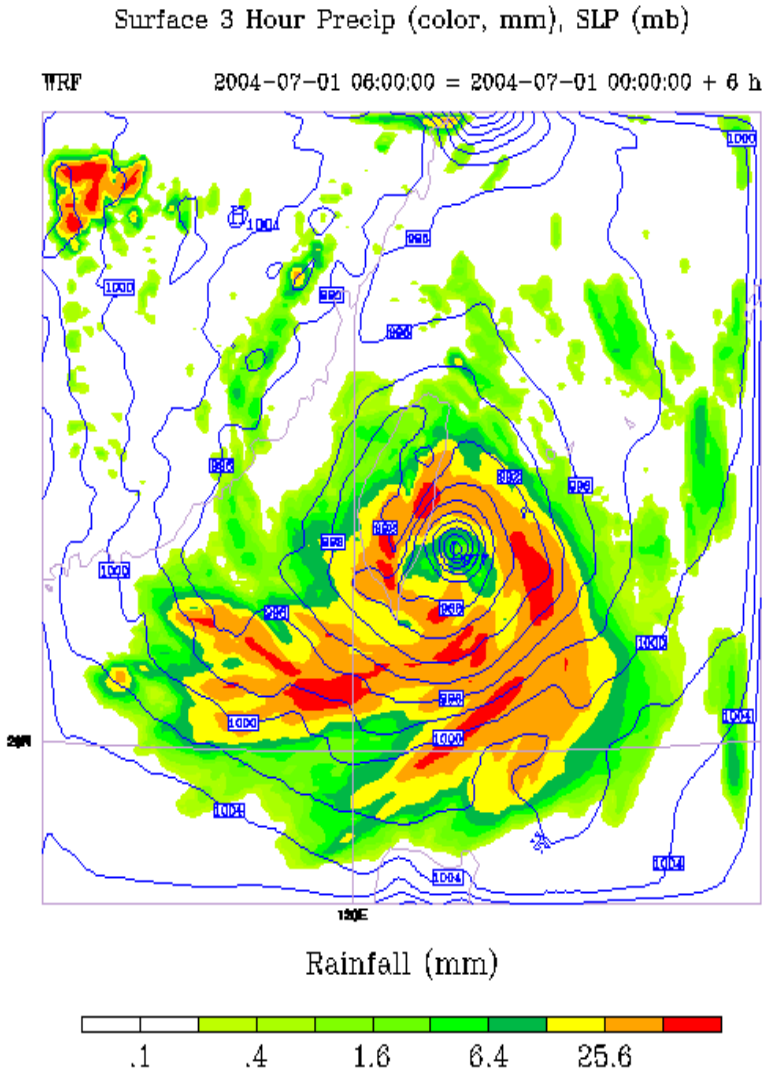
Forecast Hr / Model Config	3 Hr	6 Hr	12 Hr	All Hrs
Eta	2.8	2.7	3.6	3.2
Cold Start WRF	2.6	2.7	2.9	2.8
Hot Start WRF	2.2	2.5	2.9	2.7

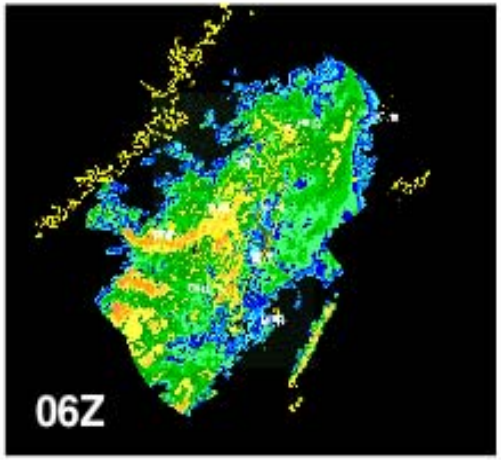
WRF Run for Typhoon Mindulle using NCEP GFS/NF-15 backgrounds

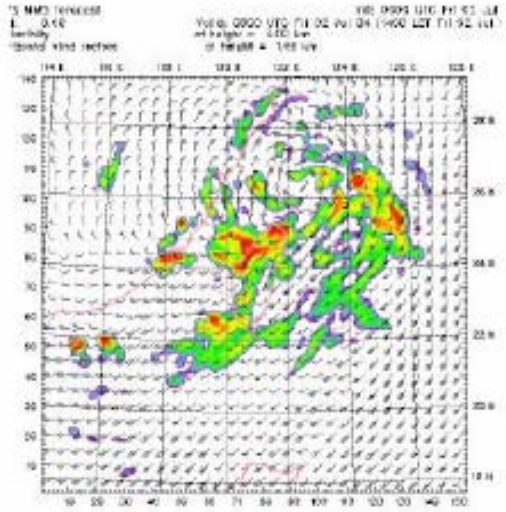
Cold -GFS

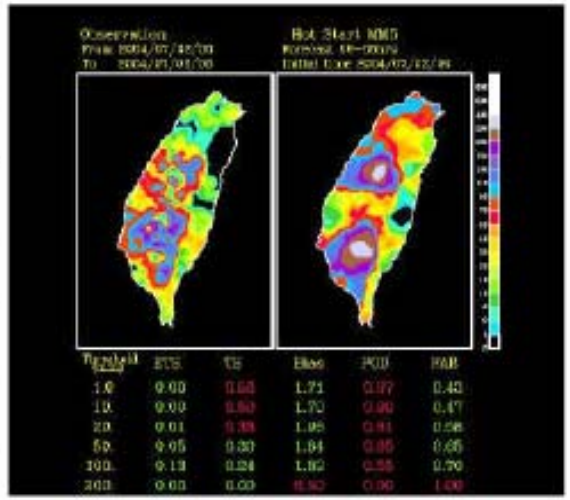


Hot - NFS

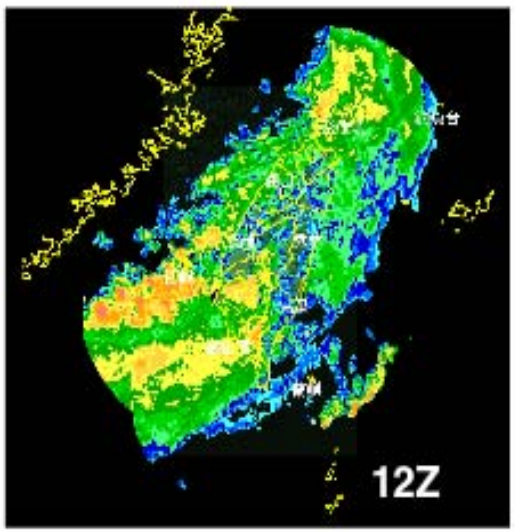


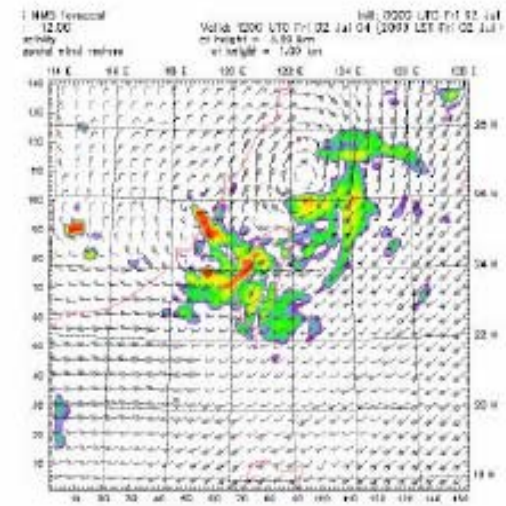


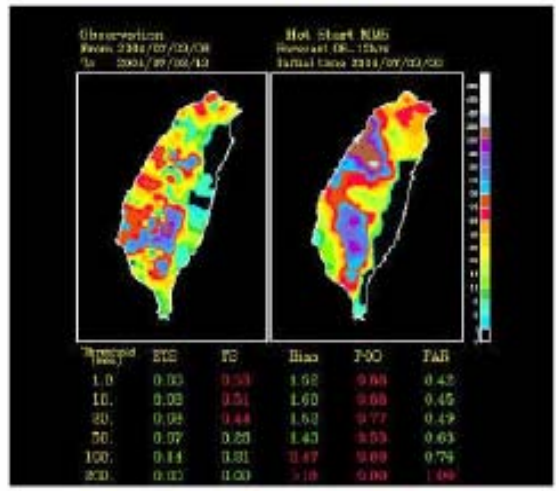




TS .60, .50,.38,.35,.26







TS .53, .51,.44,.29,.26

Skill scores in other areas for convective precipitation 0-24 hr

		1mm to 50mm
IHOP- US Central Plains -	ETS scores	0.2 to 0.10
CSI Project - Florida -	ETS scores	0.2 to 0.05
Hurricane Bonnie - Florida -	ETS scores	0.3 to 0.05
WGNE (Aus) Tropical Study -	ETS scores	0.3 to 0.05
Mei-Yu Ensemble Study -	ETS scores	0.2 to 0.05

AWIPS Evaluation Results:

- 87% increase in product use in last 7 years - ***performance is still an issue*.**
- Base radar products (reflectivity and velocity) are still heavily relied on compared to derived radar products.
- Integrated capabilities is critical for operational forecasting. (ALPS can provide this.)